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Application Translation

RADIO OPERATING SYSTEM AND METHOD FOR OPERATING A RADIO SYSTEM

The invention relates to a radio operating system, particularly for a medical device, and to a method for operating a radio system.

For operating a device, especially a medical device, such as an X-ray system, an operating element that is not stationary is often provided. A cable-connected operating element is known for instance from European Patent Disclosure EP 0 834 891 A2. From it, the possibility is also known of linking an operating element to a central station in cordless fashion, for instance via an infrared connection. A cordless connection can in principle also be made by means of radio communication. In contrast to an infrared connection, no visual connection would be necessary between the operating element and the central station, or in other words the device to be triggered. However, that has a disadvantage that a person operating the equipment who while carrying the operating element is moving away from the device to be triggered could change the device settings by unintentionally tripping the operating element. Particularly in the case of medical devices, such an event can be extremely safety-critical. For safety-critical functions of medical devices, radio operations are therefore typically not used.

The invention has the object of expanding the range of use of radio operating systems, particularly for medical

devices.

This object is attained according to the invention by a radio operating system having the characteristics of claim 1 and by a method for operating a radio system having the characteristics of claim 6. The features and advantages listed below in conjunction with the system apply analogously to the method, and vice versa.

The radio system that can be operated in accordance with the invention includes what is in general a stationary radio base station and an operating element that in general is not stationary, and these are also known for short as the parties to the radio system. An expansion by an arbitrary number of additional stationary or portable parties is also possible. Without restricting the general applicability, the assumption below will be a single radio base station and a single operating element, between which radio communication is to be established.

The radio communication between the parties of the radio system can be made in various operating modes. To that end, one of the parties, preferably the operating unit, has a control unit with a first threshold value relating to a reception parameter. The reception parameter, for instance as a reception quality parameter, relates to the reception field intensity, or in the case of digital radio communication, to the bit error rate of the data transmitted. For classifying the reception quality, both the reception field intensity and the bit error rate are preferably used. A measurement or estimate of the distance between the parties of the radio

system, made to ascertain the reception parameter, is preferably provided directly by means of a transit time measurement and/or indirectly by the evaluation of the reception quality. For simplicity, the terms "reception parameter" and "reception quality parameter" are also used for cases in which the reception properties ascertained, in particular the reception quality, are characterized by a plurality of parameters.

As a function of whether the threshold value is exceeded or is undershot by the reception parameter, particularly the reception quality parameter, a standard operating mode or a safety-oriented operating mode of the radio system is activated. Information transmission in the radio system is possible by means of two different command sets, namely a first, non-safety-critical command set and a second, safety-critical command set. As long as the operation of the radio system is taking place in the standard operating mode, both command sets are usable without restriction. Conversely, if a switchover is made to the safety-oriented operating mode, or in other words the reception quality becomes worse and/or the distance between the parties increases beyond the limit set by the threshold value, then only the first, non-safety-critical command set is usable without restrictions. With regard to the use of the second command set, restrictions are automatically made in the safety-oriented operating mode.

In the simplest case, the second command set is blocked entirely in the safety-oriented operating mode. However, the use of the second command set preferably remains possible in

the safety-oriented operating mode, as long as a confirmation input device, such as a confirmation key, is actuated. In a first alternative, it is provided that the use of the second command set is enabled only during the actuation of the confirmation input device. In a second alternative, by the actuation of the confirmation input device in the safety-oriented operating mode, a time slot is opened within which all the command sets, and hence the full functional scope of the standard operating mode, are enabled. In that case, the confirmation input device has the function of a trigger key. Preferably, the time slot that has been opened is retriggered after the termination of the operating function tripped by one of the command sets and is thus still open, in a further time interval, for subsequent operation requirements with an arbitrary command set. This version is especially advantageous when an operating element is embodied as a cordless pedal switch.

Instead of dividing up the functions of the operating element into two command sets from the standpoint of safety, a more finely graduated classification may be expedient - depending on the type of the device to be triggered. For instance, for functions that for safety reasons should be enabled in every case, especially emergency shutoff functions, it may be provided that to the extent they can be tripped by the operating element, lower thresholds are set with regard to the required reception quality that for other operating functions required for the intended operation of the device to be triggered.

For displaying the active operating mode, and

especially when the safety-oriented operating mode is activated, an optical display device of a party, in particular the operating element, is preferably provided. By the automatic activation of the optical display, for instance in the form of a blinking lighted display, the user is directed, upon switchover from the standard operating mode to the safety-oriented operating mode, to the fact that the reception quality measured by the party at its site is becoming less and/or the distance between the parties of the radio system are becoming greater. An acoustic warning report is not output, in a preferred embodiment, until the user intentionally or unintentionally actuates an input device, especially a key, of the operating element, with which a function associated with the second, safety-critical command set, is selected.

By means of the solely optical but not acoustic report in the case of a reception quality below the threshold value, the user carrying the operating element with him is made aware, in a way that does not disturb other persons, that he is located at the far end of the range. This also takes into account the fact that the range of the radio communication can be diminished by the most various damping factors, such as many persons present in one room where the parties of the radio system are also located. In such a case, if the reception parameter drops below the threshold value, then the optical report should be understood as an instruction to look for a more-suitable site for system operation.

If the transit time of a signal forwarded between the parties, instead of the reception quality at the site of one

of the parties of the radio system, is at least primarily determinative for the definition of the reception parameter, then this makes it especially simple, in a locally defined way, to limit the region in which radio communication between the parties is enabled without restriction. In this way, it is for instance reliably possible to preclude the tripping of safety-critical functions of the device with a radio-based operating element, which is intended for operating a device set up in stationary fashion in one room, from a neighboring room.

In a preferred refinement, a second threshold value pertaining to a reception parameter is provided; if it is undershot, the radio communication between the parties is shut off. Regardless of whether the termination of the radio communication is done because of undershooting of the second threshold value or solely based on given physical conditions, especially an excessive distance between the parties, without the fixation of this kind of defined threshold value, it is provided in a preferred embodiment that an acoustic report be output that informs the user about the establishment of the radio communication. This makes it easy to prevent a user from unintentionally carrying the operating element out of reception range, for instance in his pocket.

The advantage of the invention is in particular that because of the complete or conditional blocking of part of the functional scope of a radio-operated device, if the radio reception quality drops below a fixed threshold value and/or over a distance, ascertained by transit time measurement, that is increasing beyond the maximum distance specified by

the threshold value, between the device and the device to be triggered, the unrestricted use of the radio operating element remains limited in the desired way to the near vicinity of the device, in particular the medical device, that is to be triggered.

One exemplary embodiment of the invention is described in further detail below in terms of the drawing. In the drawing, in each case schematically:

Fig. 1 shows a radio operating system for a medical device; and

Fig. 2, in a flow chart, shows various operating states of the radio operating system of Fig. 1.

Elements or parameters corresponding to one another are identified by the same reference numerals in both drawings.

A radio operating system 1 includes a stationary radio base station 2 and a portable operating element 3. A medical device 4 to be triggered, such as an X-ray system or lithotripsy system, is connected to the radio base station 2. The functional scope of the device 4 includes safety-relevant functions, such as switching drives or radiation sources, and functions that are not relevant to safety, such as display functions. Both safety-critical and non-safety-critical functions of the device 4 can be controlled by means of the operating element 3. Radio communication between the operating element 3 and the radio base station 2 is established by means of antennas 5, 6, and the maximum range

is approximately 5 to 8 meters. As a rule, the user actuating the operating element 3 works under the safety specification of maintaining a visual connection with the device 4 to be triggered and thus in general also with the radio base station 2, which is typically installed on or in the device 4. For instance, if the radio base station 2 is covered by a cloth hanging down from an examination table, this is practically no impairment to the radio communication, which is shown in dashed lines and marked FV. To this extent, the radio communication between the radio base station 2 and the operating element 3 offers significant advantages, for instance over an infrared connection. On the other hand, however, the possibility that the user by unintentionally actuating the operating element 3 without visual contact with the device 4, for instance in an antechamber to the examination chamber or to the operating room where the device 4 is set up, will undesirably trip functions of the device 4 cannot fundamentally be precluded. This danger is effectively counteracted by operating the operating element 3 in operating modes B0, B1, described in further detail below, and also with reference to the flow chart of Fig. 2.

The operating element 3 has a radio module 7, which carries information about the field intensity, measured by means of the antenna 5, and about the bit error rate of the received data on to a control unit 8, hereinafter also called controller for short. In addition or as an alternative, the distance between the antennas 5, 6 of the parties 2, 3 is ascertained by transit time measurement in the radio operating system 1.

The controller 8 is also connected to a keypad 9, a keypad controller 10, and a speaker 11 as an acoustic output device. The keypad 9, in the exemplary embodiment shown in simplified form, includes four function keys F1, F2, F3, F4; the designations F1 through F4 represent the functions of the device 4 that can be triggered by the operating element 3. The functions F1, F2 are assigned to a first, non-safety-critical command set BS1, and the functions F3, F4 are assigned to a second, safety-critical command set BS2. As long as the user carrying the operating element 3 maintains a slight distance, intended for regular operation of the device 4, and no significant shields are in the way, all the functions F1 through F4 are enabled without restriction: The operating element 3 is in the standard operating mode B1.

As the distance between the operating element 3 and the radio base station 2, as the parties of the radio operating system 1, increases, and/or if there are shields between the parties 2, 3, for instance in the form of a wall in a building, the reception quality of the data stream originating at the radio base station 2, which quality is detectable by means of the antenna 5 of the operating element 3, becomes worse. The reception quality at the site of the operating element 3 is converted, preferably by measuring the field intensity and ascertaining the bit error rate, into at least one reception quality parameter K, or reception parameter or parameter for short, which serves the controller 8 as an input variable. Alternatively, the reception parameter K is a measure for the distance between the parties 2, 3 of the radio system, and a decreasing reception parameter K corresponds to an increasing spacing between the

parties 2, 3. The controller 8 compares the parameter K, generated by the radio module 7, with a first threshold value S1. The split into the radio module 7 on the one hand and the controller 8 on the other should be understood as merely symbolic. In fact, a plurality or all of the components, that is, the radio module 7, controller 8 and keypad controller 10, are for instance embodied as one integral component, and both open- and closed-loop control functions can also be attained by software. It is equally possible as an alternative, for functions shown symbolically inside the operating element 3 also to be integrated with the radio base station 2 and/or the device 4.

If the first threshold value S1 is undershot by the reception parameter K, or in other words particularly if the reception quality is becoming less, a further, safety-oriented operating mode B0 is activated. The functions F1, F2 associated with the first, non-safety-critical command set BS1 are enabled without change. Conversely, the functions F3, F4 associated with the second, safety-critical command set BS2 are not usable merely by actuating the corresponding keys of the operating element 3. Instead, to enable the safety-critical functions F3, F4, the actuation of an enabled key 12, as a confirmation input device, is required. In a first alternative, the use of the functions F3, F4 of the safety-critical command set BS2 is enabled only as long as the enable key 12 continues to be depressed. In a second alternative, the full functional scope of the standard operating mode B1 that includes both command sets BS1, BS2 is enabled, for instance for a period of 10 seconds, by brief actuation of the enable key 12. The user is informed of the

necessity of actuating the enable key 12 by an acoustic warning signal output by the speaker 11, as soon as he selects one of the functions F3, F4 in the safety-oriented operating mode B0 without enabling them. In this way, it is reliably precluded that the user will unintentionally trip a safety-critical function of the device 4. The restricted use, possible in this exemplary embodiment only after actuation of the enable key 12, of the safety-critical command set BS2 in the safety-oriented operating mode B0 is symbolized in Fig. 2 by the term BS2 enclosed in parentheses.

If the user, carrying the operating element 3, moves out of the near vicinity of the radio base station 2 within which the standard operating mode B0 is possible, an acoustic warning is not automatically given. The safety-oriented operating mode B0 activated in that case, however, is displayed by means of a light-emitting diode 13 as a display device in an undisturbing way. If only the functions F1, F2 associated with the non-safety-critical command set BS1 are selected, no acoustic report is made. At the same time, the user is informed of the fact that he is located in a region of reduced reception field intensity and/or an increased bit error rate. In this way, great user friendliness of the radio operating system 1 is provided for.

If the operating element 3 is moved farther from the radio base station 2, or the reception quality of the location of the antenna 5 is further reduced in some other way, then the parameter K drops below a threshold value S2 specified in the controller 8. In that case, all the functions F1 through F4 are blocked. Information to the user

is accordingly provided by an acoustic report, output via the speaker 11, for instance as a defined sequence of tones, or as speech output. If the operating element 3, in addition to the keypad 9 or combined with it, also has an optical output device, for instance in the form of a touch sensitive screen, then the output of an optical report, for instance in the form of a clear text display, is preferably provided in addition or alternatively.

Claims

1. A radio operating system having

- a radio base station (2) provided for controlling a device;

- an operating element (3), provided for establishing radio communication with the radio base station, wherein

- the operating element (3) has a control unit (8), with a first threshold value (S1) relating to a reception parameter (K), as a function of which a switchover is provided between various operating modes (B0, B1) of the operating element (3);

- upon undershooting of the threshold value (S1), a safety-oriented operating mode (B0) is provided and if the threshold value (S1) is exceeded, a standard operating mode (B1) of the operating element (3) is provided,

- a first, non-safety-critical command set (BS1), activatable by means of the operating element (3), is usable equally in the various operating modes (B0, B1);

- a second, safety-critical command set (BS2), activatable by means of the operating element (3), is usable in the safety-oriented operating mode (B0), if at all, only with restrictions, compared to the standard operating mode (B1).

2. The radio operating system as recited in claim 1, characterized by a confirmation input device (12), by whose actuation the safety-critical command set (BS2) is usable in the safety-oriented operating mode (B0) in a way corresponding to the standard operating mode (B1).

3. The radio operating system as recited in claim 1 or 2, characterized in that the operating element (3) has a display device (13) provided for displaying the operating mode (B0, B1).

4. The radio operating system as recited in one of claims 1 through 3, characterized in that the operating element (3) has an acoustic output device (11).

5. The radio operating system as recited in one of claims 1 through 4, characterized by a second threshold value (S2) pertaining to a reception parameter (K), upon whose undershooting, switching off of the radio connection between the operating element (3) and the radio base station (2) is provided.

6. A method for operating a radio system having at least two parties , wherein

- the transmission quality of the radio communication between the parties (2, 3) is measured;

- the transmission quality is compared, on the basis of a reception parameter (K), with a threshold value (S1);

- as a function of the magnitude of the reception parameter (K) in relation to the threshold value (S1), various operating modes (B0, B1) are activated, namely a safety-oriented operating mode (B0) if the threshold value (S1) is undershot and a standard operating mode (B1) if the threshold value is exceeded;

- for operating the radio communication, a first, non-safety-critical command set (BS1), and a second, safety-critical command set (BS2) are provided;

- the use of both command sets (BS1, BS2) is enabled without restriction in the standard operating mode (B1);

- in the safety-oriented operating mode (B0), the use of only the first command set (BS1) is enabled without restriction, while the usability of the second command mode (BS2) is restricted.

7. The method as recited in claim 6, characterized in that the full functional scope of the standard operating mode (B1) is enabled in the safety-oriented operating mode (B0) by actuation of a confirmation input device (12).

8. The method as recited in claim 7, characterized in that the use of the full functional scope of the standard operating mode (B1) is enabled in the safety-oriented operating mode (B0) solely during the actuation of the confirmation input device (12).

9. The method as recited in claim 7, characterized in

that by the actuation of the confirmation input device (12) in the safety-oriented operating mode (B0), a time slot is opened, within which the functional scope of the standard operating mode (B1) is enabled.

10. The method as recited in one of claims 6 through 9, characterized in that upon switchover from the standard operating mode (B1) to the safety-oriented operating mode (B0), an optical report is output.

11. The method as recited in one of claims 6 through 10, characterized in that if a function associated with the safety-critical command set (BS2) is chosen in the safety-oriented operating mode (B1), an acoustic warning report is output.

12. The method as recited in one of claims 6 through 11, characterized in that if the radio communication between the parties (2, 3) is broken because of the transmission quality, an acoustic report is output.

13. The method as recited in one of claims 6 through 12, characterized in that the reception parameter (K) contains information pertaining to the reception quality of the radio communication between the parties (2, 3).

14. The method as recited in claim 13, characterized in that the reception parameter (K) contains information pertaining to the reception field intensity at the location of one party (2, 3).

15. The method as recited in claim 13 or 14, characterized in that the reception parameter (K) includes information pertaining to the bit error rate of the radio communication between the parties (2, 3).

16. The method as recited in one of claims 6 through 15, characterized in that the reception parameter (K) includes information pertaining to the distance between the parties (2, 3).

17. The method as recited in claim 16, characterized in that the reception parameter (K) is ascertained by transit time measurement.

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For operating a device, especially a medical device, such as an X-ray system, an operating element that is not stationary is often provided. A cable-connected operating element is known for instance from European Patent Disclosure EP 0 834 891 A2. From it, the possibility is also known of linking an operating element to a central station in cordless fashion, for instance via an infrared connection. A cordless connection can in principle also be made by means of radio communication. In contrast to an infrared connection, no visual connection would be necessary between the operating element and the central station, or in other words the device to be triggered. However, that has a disadvantage that a person operating the equipment who while carrying the operating element is moving away from the device to be triggered could change the device settings by unintentionally tripping the operating element. Particularly in the case of medical devices, such an event can be extremely safety-critical. For safety-critical functions of medical devices, radio operations are therefore typically not used.

The invention has the object of expanding the range of use of radio operating systems, particularly for medical

devices.

This object is attained according to the invention by a radio operating system having the characteristics of claim 1 and by a method for operating a radio system having the characteristics of claim 6. The features and advantages listed below in conjunction with the system apply analogously to the method, and vice versa.

The radio system that can be operated in accordance with the invention includes what is in general a stationary radio base station and an operating element that in general is not stationary, and these are also known for short as the parties to the radio system. An expansion by an arbitrary number of additional stationary or portable parties is also possible. Without restricting the general applicability, the assumption below will be a single radio base station and a single operating element, between which radio communication is to be established.

The radio communication between the parties of the radio system can be made in various operating modes. To that end, one of the parties, preferably the operating unit, has a control unit with a first threshold value relating to a reception parameter. The reception parameter, for instance as a reception quality parameter, relates to the reception field intensity, or in the case of digital radio communication, to the bit error rate of the data transmitted. For classifying the reception quality, both the reception field intensity and the bit error rate are preferably used. A measurement or estimate of the distance between the parties of the radio

system, made to ascertain the reception parameter, is preferably provided directly by means of a transit time measurement and/or indirectly by the evaluation of the reception quality. For simplicity, the terms "reception parameter" and "reception quality parameter" are also used for cases in which the reception properties ascertained, in particular the reception quality, are characterized by a plurality of parameters.

As a function of whether the threshold value is exceeded or is undershot by the reception parameter, particularly the reception quality parameter, a standard operating mode or a safety-oriented operating mode of the radio system is activated. Information transmission in the radio system is possible by means of two different command sets, namely a first, non-safety-critical command set and a second, safety-critical command set. As long as the operation of the radio system is taking place in the standard operating mode, both command sets are usable without restriction. Conversely, if a switchover is made to the safety-oriented operating mode, or in other words the reception quality becomes worse and/or the distance between the parties increases beyond the limit set by the threshold value, then only the first, non-safety-critical command set is usable without restrictions. With regard to the use of the second command set, restrictions are automatically made in the safety-oriented operating mode.

In the simplest case, the second command set is blocked entirely in the safety-oriented operating mode. However, the use of the second command set preferably remains possible in

the safety-oriented operating mode, as long as a confirmation input device, such as a confirmation key, is actuated. In a first alternative, it is provided that the use of the second command set is enabled only during the actuation of the confirmation input device. In a second alternative, by the actuation of the confirmation input device in the safety-oriented operating mode, a time slot is opened within which all the command sets, and hence the full functional scope of the standard operating mode, are enabled. In that case, the confirmation input device has the function of a trigger key. Preferably, the time slot that has been opened is retriggered after the termination of the operating function tripped by one of the command sets and is thus still open, in a further time interval, for subsequent operation requirements with an arbitrary command set. This version is especially advantageous when an operating element is embodied as a cordless pedal switch.

Instead of dividing up the functions of the operating element into two command sets from the standpoint of safety, a more finely graduated classification may be expedient - depending on the type of the device to be triggered. For instance, for functions that for safety reasons should be enabled in every case, especially emergency shutoff functions, it may be provided that to the extent they can be tripped by the operating element, lower thresholds are set with regard to the required reception quality that for other operating functions required for the intended operation of the device to be triggered.

For displaying the active operating mode, and

especially when the safety-oriented operating mode is activated, an optical display device of a party, in particular the operating element, is preferably provided. By the automatic activation of the optical display, for instance in the form of a blinking lighted display, the user is directed, upon switchover from the standard operating mode to the safety-oriented operating mode, to the fact that the reception quality measured by the party at its site is becoming less and/or the distance between the parties of the radio system are becoming greater. An acoustic warning report is not output, in a preferred embodiment, until the user intentionally or unintentionally actuates an input device, especially a key, of the operating element, with which a function associated with the second, safety-critical command set, is selected.

By means of the solely optical but not acoustic report in the case of a reception quality below the threshold value, the user carrying the operating element with him is made aware, in a way that does not disturb other persons, that he is located at the far end of the range. This also takes into account the fact that the range of the radio communication can be diminished by the most various damping factors, such as many persons present in one room where the parties of the radio system are also located. In such a case, if the reception parameter drops below the threshold value, then the optical report should be understood as an instruction to look for a more-suitable site for system operation.

If the transit time of a signal forwarded between the parties, instead of the reception quality at the site of one

of the parties of the radio system, is at least primarily determinative for the definition of the reception parameter, then this makes it especially simple, in a locally defined way, to limit the region in which radio communication between the parties is enabled without restriction. In this way, it is for instance reliably possible to preclude the tripping of safety-critical functions of the device with a radio-based operating element, which is intended for operating a device set up in stationary fashion in one room, from a neighboring room.

In a preferred refinement, a second threshold value pertaining to a reception parameter is provided; if it is undershot, the radio communication between the parties is shut off. Regardless of whether the termination of the radio communication is done because of undershooting of the second threshold value or solely based on given physical conditions, especially an excessive distance between the parties, without the fixation of this kind of defined threshold value, it is provided in a preferred embodiment that an acoustic report be output that informs the user about the establishment of the radio communication. This makes it easy to prevent a user from unintentionally carrying the operating element out of reception range, for instance in his pocket.

The advantage of the invention is in particular that because of the complete or conditional blocking of part of the functional scope of a radio-operated device, if the radio reception quality drops below a fixed threshold value and/or over a distance, ascertained by transit time measurement, that is increasing beyond the maximum distance specified by

the threshold value, between the device and the device to be triggered, the unrestricted use of the radio operating element remains limited in the desired way to the near vicinity of the device, in particular the medical device, that is to be triggered.

One exemplary embodiment of the invention is described in further detail below in terms of the drawing. In the drawing, in each case schematically:

Fig. 1 shows a radio operating system for a medical device; and

Fig. 2, in a flow chart, shows various operating states of the radio operating system of Fig. 1.

Elements or parameters corresponding to one another are identified by the same reference numerals in both drawings.

A radio operating system 1 includes a stationary radio base station 2 and a portable operating element 3. A medical device 4 to be triggered, such as an X-ray system or lithotripsy system, is connected to the radio base station 2. The functional scope of the device 4 includes safety-relevant functions, such as switching drives or radiation sources, and functions that are not relevant to safety, such as display functions. Both safety-critical and non-safety-critical functions of the device 4 can be controlled by means of the operating element 3. Radio communication between the operating element 3 and the radio base station 2 is established by means of antennas 5, 6, and the maximum range

is approximately 5 to 8 meters. As a rule, the user actuating the operating element 3 works under the safety specification of maintaining a visual connection with the device 4 to be triggered and thus in general also with the radio base station 2, which is typically installed on or in the device 4. For instance, if the radio base station 2 is covered by a cloth hanging down from an examination table, this is practically no impairment to the radio communication, which is shown in dashed lines and marked FV. To this extent, the radio communication between the radio base station 2 and the operating element 3 offers significant advantages, for instance over an infrared connection. On the other hand, however, the possibility that the user by unintentionally actuating the operating element 3 without visual contact with the device 4, for instance in an antechamber to the examination chamber or to the operating room where the device 4 is set up, will undesirably trip functions of the device 4 cannot fundamentally be precluded. This danger is effectively counteracted by operating the operating element 3 in operating modes B0, B1, described in further detail below, and also with reference to the flow chart of Fig. 2.

The operating element 3 has a radio module 7, which carries information about the field intensity, measured by means of the antenna 5, and about the bit error rate of the received data on to a control unit 8, hereinafter also called controller for short. In addition or as an alternative, the distance between the antennas 5, 6 of the parties 2, 3 is ascertained by transit time measurement in the radio operating system 1.

The controller 8 is also connected to a keypad 9, a keypad controller 10, and a speaker 11 as an acoustic output device. The keypad 9, in the exemplary embodiment shown in simplified form, includes four function keys F1, F2, F3, F4; the designations F1 through F4 represent the functions of the device 4 that can be triggered by the operating element 3. The functions F1, F2 are assigned to a first, non-safety-critical command set BS1, and the functions F3, F4 are assigned to a second, safety-critical command set BS2. As long as the user carrying the operating element 3 maintains a slight distance, intended for regular operation of the device 4, and no significant shields are in the way, all the functions F1 through F4 are enabled without restriction: The operating element 3 is in the standard operating mode B1.

As the distance between the operating element 3 and the radio base station 2, as the parties of the radio operating system 1, increases, and/or if there are shields between the parties 2, 3, for instance in the form of a wall in a building, the reception quality of the data stream originating at the radio base station 2, which quality is detectable by means of the antenna 5 of the operating element 3, becomes worse. The reception quality at the site of the operating element 3 is converted, preferably by measuring the field intensity and ascertaining the bit error rate, into at least one reception quality parameter K, or reception parameter or parameter for short, which serves the controller 8 as an input variable. Alternatively, the reception parameter K is a measure for the distance between the parties 2, 3 of the radio system, and a decreasing reception parameter K corresponds to an increasing spacing between the

parties 2, 3. The controller 8 compares the parameter K, generated by the radio module 7, with a first threshold value S1. The split into the radio module 7 on the one hand and the controller 8 on the other should be understood as merely symbolic. In fact, a plurality or all of the components, that is, the radio module 7, controller 8 and keypad controller 10, are for instance embodied as one integral component, and both open- and closed-loop control functions can also be attained by software. It is equally possible as an alternative, for functions shown symbolically inside the operating element 3 also to be integrated with the radio base station 2 and/or the device 4.

If the first threshold value S1 is undershot by the reception parameter K, or in other words particularly if the reception quality is becoming less, a further, safety-oriented operating mode B0 is activated. The functions F1, F2 associated with the first, non-safety-critical command set BS1 are enabled without change. Conversely, the functions F3, F4 associated with the second, safety-critical command set BS2 are not usable merely by actuating the corresponding keys of the operating element 3. Instead, to enable the safety-critical functions F3, F4, the actuation of an enabled key 12, as a confirmation input device, is required. In a first alternative, the use of the functions F3, F4 of the safety-critical command set BS2 is enabled only as long as the enable key 12 continues to be depressed. In a second alternative, the full functional scope of the standard operating mode B1 that includes both command sets BS1, BS2 is enabled, for instance for a period of 10 seconds, by brief actuation of the enable key 12. The user is informed of the

necessity of actuating the enable key 12 by an acoustic warning signal output by the speaker 11, as soon as he selects one of the functions F3, F4 in the safety-oriented operating mode B0 without enabling them. In this way, it is reliably precluded that the user will unintentionally trip a safety-critical function of the device 4. The restricted use, possible in this exemplary embodiment only after actuation of the enable key 12, of the safety-critical command set BS2 in the safety-oriented operating mode B0 is symbolized in Fig. 2 by the term BS2 enclosed in parentheses.

If the user, carrying the operating element 3, moves out of the near vicinity of the radio base station 2 within which the standard operating mode B0 is possible, an acoustic warning is not automatically given. The safety-oriented operating mode B0 activated in that case, however, is displayed by means of a light-emitting diode 13 as a display device in an undisturbing way. If only the functions F1, F2 associated with the non-safety-critical command set BS1 are selected, no acoustic report is made. At the same time, the user is informed of the fact that he is located in a region of reduced reception field intensity and/or an increased bit error rate. In this way, great user friendliness of the radio operating system 1 is provided for.

If the operating element 3 is moved farther from the radio base station 2, or the reception quality of the location of the antenna 5 is further reduced in some other way, then the parameter K drops below a threshold value S2 specified in the controller 8. In that case, all the functions F1 through F4 are blocked. Information to the user

is accordingly provided by an acoustic report, output via the speaker 11, for instance as a defined sequence of tones, or as speech output. If the operating element 3, in addition to the keypad 9 or combined with it, also has an optical output device, for instance in the form of a touch sensitive screen, then the output of an optical report, for instance in the form of a clear text display, is preferably provided in addition or alternatively.